Commercial Growing of CARROTS

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Commercial Growing of Carrots

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The carrot is a biennial plant, one that normally requires two growing seasons with a cool rest period between, to complete its life cycle from the planting of seed to the maturing of seed. This leaflet deals only with the first season's growth—the production of roots for fresh market, processing, or storage.

The commercial acreage of carrots in the United States was more than doubled between 1930 and 1950. From 1956 to 1965 an average of 81,300 acres were harvested annually, and average yields were about 20,400 pounds per acre. California, Texas, Michigan, Arizona, and Wisconsin account for about three-fourths of the crop. Unknown, but large, quantities are grown in market gardens near towns and cities and in home gardens.

Climatic Requirements

The carrot is a "cool season" vegetable. It is best adapted to regions or seasons with relatively long periods of mild weather that are free of extremes of temperature or moisture. One variety or another, however, can be grown with some success at some season of the year almost anywhere that other vegetables are grown. The carrot requires relatively large amounts of moisture and is not tolerant to drought.

Carrots grow best at mean temperatures between 60° and 70° F. During hot, bright, sunny days young plants may be badly injured or killed by the high temperatures that develop at or just below the soil surface. Prolonged hot weather later in the development of the plants may not only retard growth and depress yield but may cause undesirable strong flavor and coarseness in the roots. Too much heat also, as in the warmer parts of this country, tends to make the roots of long varieties shorter and more blunt in shape than is typical. Temperatures much below 60° retard growth. Prolonged temperatures below 50° tend to make the roots longer, more slender, and paler in color than is typical.

Good distribution of rainfall or irrigation, or a combination of the two, throughout the growing season is necessary to keep the crop growing rapidly without interruption.

The principal varieties of carrots reach harvest stage about 75 to 85 days after planting in the spring or early summer for summer or autumn harvest, respectively. They may be planted as early as 3 weeks before the average date of the last killing frost in the spring.

For winter or early spring harvest in regions of mild autumn and winter weather, much more than 75 to 85 days is usually required to produce a crop, because most of the growing period is comparatively cool.

Varieties

The most important commercial varieties of carrots are Chantenay, Danvers, Imperator, and varieties somewhat similar to these. Varieties with long and slightly tapered roots like the Imperator are generally grown in the Southwest for fresh market. Varieties of the Chantenay and Danvers classes are

more important for processing and are grown in the Northern States.

Each class of carrot contains many varieties each of which may be better adapted for one locality than for another. Recommendations as to the newest varieties for specific uses may be obtained from your county agricultural agent or farm advisor, or from your State agricultural experiment station.

Varieties of relatively minor commercial importance include Nantes and French Forcing. Nantes is a nearly cylindrical variety of high quality that is well suited to home gardens. Because of its fragile nature, it is not extensively grown for long-distance shipment. The nearly round French Forcing is an early variety. Because of its shape it may be grown on some home garden soils that are too heavy or otherwise unfavorable for the long-rooted varieties. It is not commercially important in the United States Unless climatic and soil conditions are very favorable for carrots, the medium or half-long varieties will probably succeed somewhat better than the long varieties.

Soils

Deep sandy loam soils and muck soils are most desirable for carrot culture. Such soils are among the easiest to work, and permit good development of the edible roots. Carrots are grown successfully, however, on soils either lighter or heavier than sandy loams. Silt loams are extensively used. In irrigated districts where moisture can be accurately controlled, silt loams and even clay loams produce high yields of carrots of high quality. These heavy soils are not recommended in nonirrigated areas where soil moisture is not subject to precise control. Growing carrots on heavy soils is more difficult than on light ones, even when soil moisture is controlled. Cloddy, stony, trashy, or very shallow soils are undesirable.

Soil Preparation

The edible roots of the carrot may become misshapen as a result of poor soil structure or obstructions such as stones or coarse trash in the soil. Therefore, it is especially important that the soil for carrots be prepared for planting in the most thorough and careful manner practicable.

Maintaining adequate soil moisture for uniform germination and seedling establishment is a major problem in carrot production. Except where irrigation is available, the major objective is to produce a compact, well-pulverized seedbed that will readily conduct soil moisture from the lower depths to the germinating seed, yet will not puddle and crust during heavy rains.

Tillage operations should be done only when soil moisture is favorable, and the number of operations should be held to a minimum. Working the soil when it is too wet impairs its structure. Working the soil when either too wet or too dry will greatly increase the number of tillage operations required to prepare a seedbed.

Excessive tillage not only is costly but, even more important, it impairs soil structure and causes crusting to be more serious. After plowing, work the soil no more than is required to produce a firm, well-pulverized seedbed. Careful attention to soil moisture during seedbed preparation is even more important than at the time of plowing.

Soil compaction should not be in excess of the requirements for germination. For the formation of well-shaped roots, the soil must be

free of obstructions, such as large dense clods or clumps of trash.

The addition of organic matter will improve soil tilth. Production of sod in the cropping system improves soil structure. Deep-rooted legumes should be utilized to the fullest to improve soil tilth.

Manures and Fertilizers

Mineral soils for carrots should be well supplied with organic matter through the use of animal manures, green manures, or composts. Heavy application of fresh or unfermented animal manure to the soil shortly before or at the time of planting is not recommended, because some evidence suggests that it may impair the shape of the roots. Fresh manure should be applied several weeks in advance of planting or to preceding crops.

Commercial fertilizer recommendations for carrots differ according to the soil requirements in specific localities. In the absence of specific recommendations for a given locality, however, the general truck-crop or home-garden fertilizers recommended by the State agricultural experiment station will be fairly satisfactory.

On muck soils, 700 to 1,000 pounds of fertilizer low in nitrogen (or without nitrogen), medium in phosphoric acid, and medium to high in potash, is recommended: In the Northwest approximately 3–10–10[1] is used; in the Middle West 0–9–18 or 3–9–18; and in the Northeast 2–8–16 or 2–8–20 to 5–10–15.

On mineral soils in the Salinas Valley of California, 60 to 100 pounds of nitrogen per acre is applied most commonly to the shipping crop of carrots. On soils requiring additions of phosphorus about 50 pounds per acre of P_2O_5 is applied, as an average. Potash is rarely necessary. In the Imperial Valley about 300 pounds per acre of treble superphosphate is applied before planting, followed by 150 to 200 pounds per acre of sodium nitrate or 125 to 175 pounds of ammonium sulfate as a side dressing early in the growing season, and finally about 30 to 50 pounds of gaseous ammonia in the irrigation water. Amounts of nitrogen applied late in the growth of the crop must be judged carefully to avoid causing excessive top growth.

In Arizona 300 to 400 pounds per acre of treble superphosphate is broadcast or 150 to 300 pounds is applied in bands at planting. Where nitrogen is needed about 300 pounds per acre of 10–20–0 or 11–22–0 fertilizer is broadcast or 150 to 200 pounds is applied in bands. About 30 pounds per acre of nitrogen is applied 4 to 6 weeks before harvest in the form of sodium nitrate or ammonium sulfate as a side dressing or as ammonia gas in the irrigation water.

In districts where furrow irrigation is used, fertilizers are broadcast on level ground and the beds are then formed; this puts much of the fertilizer about 4 inches deep in the beds. It may also be drilled about 4 inches deep and disked. In band placement, the fertilizer is put 1 to 3 inches to one side of the seed and 2 to 4 inches deep in a band about an inch wide between the seed row and the irrigation furrow.

No pesticide should be mixed with the fertilizer. Some damage to root quality has been reported following the use of certain insecticides mixed in the soil, either with the fertilizer or separately. Therefore, growers should use the greatest caution in adding any pesticide to the soil in which carrots are to be grown. Benzene hexachloride (BHC) or lindane should never be used because they give an undesirable flavor or odor, or both, to the roots. The most up-to-date recommenda-

[1] The three figures represent the percentage of nitrogen, phosphoric acid, and potash, respectively, in the fertilizer.

tions for the use of pesticides should be obtained from State or Federal agricultural agencies before applying any pesticide to carrot soils.

Planting

Planting dates depend upon local climatic conditions and the time it is desired to market the crop. Local sources of information should be consulted.

Carrot seeds are small, and germinate slowly and irregularly. The seedlings are delicate, and few can emerge through cloddy, crusty soil. If seeds are planted too deep, the seedlings may not come through; if too shallow, the soil may be so dry that it will interfere with germination, causing poor stands or failure.

In furrow-irrigated districts carrots are planted on raised beds 4 to 8 inches high. In the West and Southwest the beds are commonly about 20 inches across the top after smoothing, and 40 inches apart on centers. A row is planted near each edge of the bed. Depending upon local conditions and equipment available for handling the crop, rows may be as close as 12 inches or up to 24 inches apart, in both irrigated and nonirrigated culture. The commonest distance between rows is 18 to 20 inches. Single-row beds are sometimes used. In some regions of flat land and heavy rainfall, as in Louisiana and Florida, carrots are grown on relatively high beds for drainage.

Seeds should be covered no deeper than is necessary to place them in soil that will be moist enough to give good germination. In the heavier, irrigated soils this is about one-quarter inch. On lighter soils that dry out rapidly near the surface, seeds may be covered about one-half inch. The soil should be pressed down firmly over the seed but not packed.

If only hand tools or mechanical equipment are to be used for weed control, seeds are planted in a single straight line. It thus becomes possible to work close to every plant in the row to kill the weeds. Where chemical methods of weed control are planned, planters that scatter the seeds thinly at random over a strip 3 to 4 inches wide are now used. These planters open a wide, shallow, flat-bottomed furrow and cover the seeds at a shallow, uniform depth. This wide spacing of seeds within a wide row yields more marketable roots per foot of row than the more crowded single line of seeds. Roots that are too small for use at normal harvesttime have, as a rule, developed from seeds that were late in germinating. These laggards tend to be overshadowed by the nearby plants that start growth early.

Carrot seeds vary in size among seed lots, depending on weather and other conditions under which they were grown. Therefore, in precise planting of commercial fields the grower must carefully test and set his planters to deliver the desired number of seeds per foot of row. The percentage of germination should also be taken into account in determining the number of seeds to be sown per foot of row. For example, one-third more seed of 60-percent germination should be sown than seed of 80-percent germination.

In rows 20 inches apart 25 seeds per foot of row usually takes about 2 pounds of seed per acre when the seeds are of average size. This is a very light rate of sowing. About 30 to 40 seeds per foot is more common, and requires about 3 pounds per acre. The wide-band planters previously referred to will sow at somewhat heavier rates—up to about 50 to 60 seeds per foot or 5 pounds of seed per acre—without causing the roots to become too crowded in the row. If soil conditions are somewhat unfavorable or seed germination is near the prevailing legal minimum of 55 percent, 5 pounds is

not excessive when wide planting shoes are used.

In sowing seeds in a single line with a narrow-shoe planter, 3 to 3½ pounds of seed per acre is ample, in rows 12 inches apart. For rows 18 to 20 inches apart, 2 to 2½ pounds is enough when conditions are good.

Thinning

Hand thinning of stands of carrots that are too thick is no longer economically feasible in commercial crops. Therefore, it is of major importance that the planter be adjusted in relation to seed size, germination rate and soil conditions. Seed scattered thinly in broad rows is less likely to produce stands that are so thick as to cause malformed roots, than seed planted in a single line.

Irrigation

As mentioned under the heading Climatic Requirements, carrots require an abundant and well-distributed water supply. Even in many humid areas where irrigation is not normally used, supplemental sprinkler irrigation has given substantial increases in yield, especially on soils of low water-holding capacity. Three to six 1-inch applications over the season during short, dry spells has increased yields materially.

On muck lands that are kept moist by a high water table, the water table should be kept at 30 to 36 inches below the soil surface.

For crops grown during long rainless periods the amount of irrigation water required depends on such factors as soil character, rate of evaporation, and amount of water in the soil at planting time. The total amount of water needed, including both that in the soil at planting plus rainfall or irrigation after planting, ranges from about 1½ to 3 acre-feet. In the less hot districts where the evaporation rate is moderate the equivalent of about an inch of water per week is applied at intervals of 10 days to 2 weeks, amounting to 1½ to 2 acre-feet. In the warmer and dryer districts, applications are heavier or more frequent or both—usually more than an inch every 7 to 10 days, amounting to 2½ to 3 acre-feet of water.

Weed Control and Cultivation

An economical way to control annual weeds in carrot plantings is by cultivating between the rows and band-spraying the rows with stoddard solvent, a petroleum product. Stoddard solvent kills many annual weed grasses and most annual broadleaf weeds. Galinsoga and ragweed are not killed by the solvent, nor are perennial grasses.

The solvent may be applied before carrots emerge or after the first true leaves appear on the carrot plant. Apply the solvent full strength when the weeds are in their early stages of growth. Use enough solvent to wet the weed foliage thoroughly—40 to 120 gallons per acre, the amount depending on the size and number of weeds. To avoid crop injury, apply the solvent when carrot leaves are free from surface moisture.

Stoddard solvent is most effective at temperatures between 70° and 80° F. Slower but effective action occurs at lower temperatures.

Two applications of stoddard solvent usually are sufficient to control most annual weeds during growth of the carrot crop. To avoid adverse effects on carrot flavor, do not apply solvent later than 6 weeks before harvest.

Carpetweed, chickweed, dodder, Florida pursley, knotweed, lambsquarters, annual morning-glory, purslane, and smartweed can be controlled in the germinating stage by application of CIPC immediately after the carrots are planted.

Both spray and granular formulations of CIPC are available.

Many annual weeds are killed by linuron sprays applied after carrots are 3 to 6 inches tall. Applications of 1 to 4 pounds per acre of 50-percent linuron wettable powder may be used, the amount depends on the severity of the weed problem. Use enough of the spray to thoroughly wet the weed foliage.

On carrot crops grown for seed, 6 to 14 pounds per acre of 75-percent DCPA wettable powder applied before emergence of weeds and carrots kills many germinating annual grasses and certain broadleafed weeds. Use low rates on sandy soils.

For information on weed control in carrot fields, contact your county agricultural agent or State agricultural experiment station.

Even with good chemical control of weeds some mechanical cultivation is desirable after growth of the crop is well advanced, to control late-emerging weeds. This applies particularly in irrigated districts where the carrots are grown on beds separated by wide furrows. At the last cultivation a little soil should be thrown onto the row to cover the "shoulders" or topmost part of the roots that may be showing above the soil surface. An undesirable amount of green color would otherwise develop in this exposed portion of the root. The covering of the shoulders should be done at such a stage of crop growth and in such a way that it will not interfere with top growth.

Harvesting and Preparing for Market

Most varieties of carrots are held so firmly in mineral soils that in harvesting commercial plantings, the roots must be loosened with a carrot lifter or plow. If no lifter is available, removal of the roots is aided by first "barring off" each row with a plow. If the roots are to be marketed with the tops on, they are bunched in the field. They are then hauled to central packing sheds where they are washed, packed in crates with ice, and loaded in cars or trucks with ice over the load for shipment.

Most of the carrots for fresh use have the tops removed in the field. The tops are removed close to the crown to reduce danger of storage rots that might start in the decaying remains of the tops.

The roots are loaded in bulk and transported to the packing shed, then washed, sorted, and packed for shipment. The type of shipping container used depends upon the specification of the receiver. Most of the carrots prepackaged in consumer-unit film bags are shipped in wirebound boxes, but some are shipped in 50-pound mesh and polyethylene master bags. Carrots are also shipped in bulk in burlap bags and in bulk-bin boxes. Loads of carrots packed in any of these containers are shipped under top ice.

Carrots shipped in kraft-paper bags and in fiberboard boxes should not be top iced. If these containers are used, the carrots should be precooled and then shipped in fan cars with bunker ice or in mechanical-refrigerator cars.

United States grades have been established for carrots prepared for marketing fresh with or without tops and from storage.

Storage

Large quantities of carrots are harvested in the autumn in the Northern States for winter storage. These storage supplies are used extensively by food processors.

The storage crop is usually loosened or plowed out of the soil and the roots are picked up by hand. A few mechanical diggers are used.

Only sound, entire roots with tops neatly and completely removed should be stored. Cold storage at a temperature of 32° to 34° F. with high humidity is best from

the standpoint of quality and long keeping. Storage in crates or similar containers is preferable to bulk storage in bins.

Diseases and Insect Pests

One or more of several diseases and insect pests attack carrots seriously in the field from time to time in various parts of the country. Generally, however, the crop is relatively free of these hazards.

Information on specific diseases and insects affecting carrots is available from your county agricultural agent, your State agricultural experiment station, and the U.S. Department of Agriculture. For information on diseases of the growing crop, write to Vegetables and Ornamentals Research Branch, Agricultural Research Service, USDA, Beltsville, Md. 20705. For information on pests of harvested and stored carrots, write to Horticultural Crops Research Branch, Agricultural Research Service, USDA, Beltsville, Md. 20705.

PRECAUTIONS

Pesticides used improperly may cause injury to man and animals. Use them only when needed and handle them with care. Follow the directions and heed all precautions on the labels.

Keep pesticides in closed, well-labeled containers in a dry place. Store them where they will not contaminate food or feed, and where children and animals cannot reach them.

When handling a pesticide, wear clean, dry clothing.

Avoid repeated or prolonged contact of pesticide with your skin.

Wear protective clothing and equipment if specified on the container label. Avoid prolonged inhalation of pesticide dusts or mists.

Avoid spilling pesticide concentrate on your skin, and keep it out of your eyes, nose, and mouth. If you spill any on your skin, wash it off immediately with soap and water. If you spill it on your clothing, launder the clothing before wearing it again.

After handling a pesticide, do not eat, drink, or smoke until you have washed your hands and face. Wash your hands and face and any other exposed skin immediately after applying pesticide.

To protect water resources, fish, and wildlife, do not contaminate lakes, streams, or ponds with pesticide. Do not clean spraying equipment or dump excess spray material near such water.

To protect honey bees and other pollinating insects that are necessary in the production of many crops, apply pesticide, when possible, during hours when the insects are not visiting the plants.

Avoid drift of pesticide to nearby bee yards, crops, or livestock.

Dispose of empty pesticide containers at a sanitary land-fill dump, or bury them at least 18 inches deep in a level, isolated place where they will not contaminate water supplies. If you have trash-collection service, wrap containers in heavy layers of newspapers and place them in the trash can.

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